PACIFIC SOUTHWEST
Forest and Range
Experiment Station

FOREST SERVICE
U.S.DEPARTMENT OF AGRICULTURE
P.O. BOX 245, BERKELEY, CALIFORNIA 94701

COPPICING TO CONVERT CULL AUSTRALIAN TOON, TROPICAL ASH TO ACCEPTABLE TREES

Gerald A. Walters Herbert L. Wick

USDA Forest Service
Research Note PSW-283
1973

LIBRARY FILE COPY

Abstract: Coppicing provides a method of converting cull sapling and pole-size Australian toon *(Toona australis)* and tropical ash *(Fraxinus uhdei)* trees to "acceptable trees." In trial plots on the island of Hawaii, stumps of both species sprouted, resulting in a high percentage of vigorous, well-formed stems. Co-dominant stems on the stump must be thinned to prevent multiple-stemmed trees. Converting Australian toon was a two-step operation: (1) cut off the original stem, and (2) cut off all but the dominant sprout in each stump. Converting tropical ash required an additional step: cut off all resprouts.

Oxford: 525.5 [+ 176.1 *Fraxinus uhdei* + 176.1 *Toona australis*] + 231.44 [+ 176.1 *Fraxinus uhdei* + 176.1 *Toona australis*].
Retrieval Terms: Fraxinus uhdei; Toona australis; Hawaii; timber stand improvement; silvicultural conversion; coppice regeneration; cull tree removal.

An objective of reforestation to produce sawtimber crops is to have an adequate number of acceptable trees well distributed over an area. Since 1959, the Hawaii Division of Forestry has planted about 5,000 acres of Australian toon *(Toona australis)* and about 1,700 acres of tropical ash *(Fraxinus uhdei)* in the Waiakea and Olaa Forest Reserves, island of Hawaii. The seedlings were usually planted at a 10- by 10-foot spacing (435 per acre) in pure stands or in mixtures. The plantings have not provided adequate numbers of acceptable trees of either species.[1] The trees vary considerably in growth form and in growth rate—even within short distances. Stocking in stands of both species is generally irregular, and many stems have less than acceptable growth rate and quality.

A 1969 survey of pole-size stands in these forest reserves determined that 26 percent of the Australian toon and 64 percent of the tropical ash were cull.[1] The trees were so classed as opposed to "acceptable" trees if they had lodged or arched stems, stem lean exceeding 8 degrees, or forks or heavy branching below 12 feet. A high incidence of cull trees reduces the potential for sawtimber yield.

Both Australian toon and tropical ash can coppice.[2] This capability could afford a method of converting culls to acceptable trees. We did an exploratory conversion trial, using coppicing on sample plots.

The results suggest that a forest manager can improve young stands of Australian toon and tropical ash by coppicing cull trees. The method may have application where the percentage of cull trees is high and the stocking with acceptable trees is low. It will not be applicable, however, if survival and growth rate are low, or total stocking is patchy. Coppicing may be a substitute for, or a supplement to a replanting operation.

This study provided no information on costs of cutting the main stem, and the subsequent thinning of sprouts. Such information is needed before the forest manager can fully appraise the applicability of coppicing in young Australian toon and tropical ash stands. But in the stands studied, coppicing is undoubtedly more efficient, tree for tree, than replanting with seedlings.

METHODS

Two sample plots were established in each of three selected Australian toon stands and in each of two tropical ash stands. The stands ranged in age from 5 to 8 years. The stands were planted on the lower east slope of Mauna Loa, Hawaii, in a rain forest zone between 1,000 and 4,000 feet elevation. Annual rainfall averages 180 inches. Lava flows of different composition and ages account for marked differences in site within short distances. Soil is mostly an extremely stony silt loam of varying depth, but generally shallow. The surface soil is very high in organic matter.

Each plot held 10 cull trees so that 60 Australian toon and 40 tropical ash trees were treated. The cull trees were about the same size and vigor as surrounding non-plot trees. The cull Australian toon trees averaged 23 feet tall and 3.4 inches d.b.h.; the largest tree was 41 feet tall and 6.1 inches d.b.h. About 57 percent were either open grown or dominant, and about 95 percent had medium or high vigor. The cull tropical ash trees averaged 16 feet tall and 2 inches d.b.h.; the largest tree was 27 feet tall and 4.1 inches d.b.h. About 95 percent were open grown or dominant and all had medium or high vigor. Forks and large branches occurring below 12 feet *(fig. 1)* accounted for about 95 percent of the Australian toon and tropical ash trees being rated cull, the other 5 percent were leaning trees.

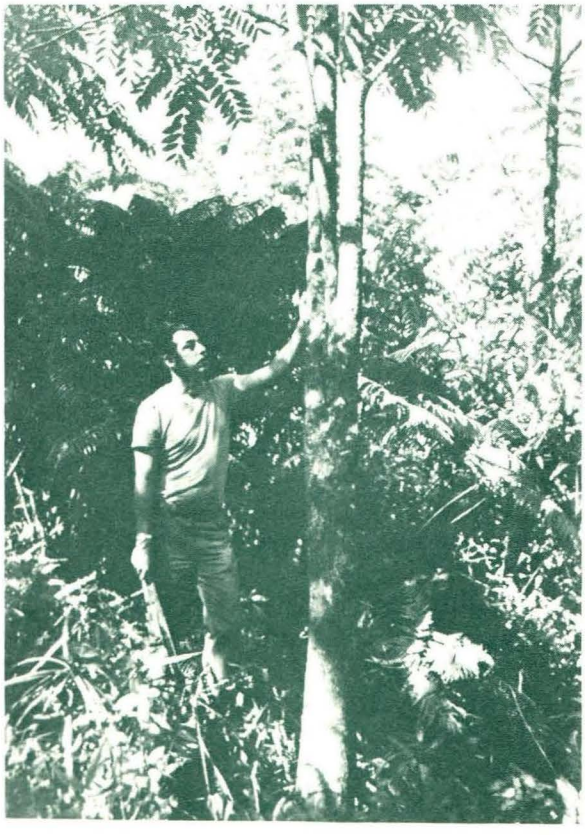

Figure 1—This Australian toon tree is classed as cull because of the fork below 12 feet. In the study, 95 percent of the trees treated were cull because of such forks and large branches below 12 inches.

Cull trees were cut off 1 foot or less above the ground. Stump heights ranged from 4 to 12 inches for Australian toon and from 4 to 8 inches for tropical ash. All stumps were cut at an angle of about 45° to shed water. Stumps were not treated with pruning paint or other substances. Each sprout that developed on a stump was tagged, and then its height, d.b.h., vigor, and form were recorded.

After 18 months, 36 percent of the Australian toon stumps and 53 percent of tropical ash stumps supported two or more codominant sprouts per stump. If these sprouts continued to grow, many trees would be forked at the base. So all but the tallest, best formed sprout on each stump were pruned off. No wounds were treated with pruning paint.

RESULTS

Australian Toon

Sprouts per stump—Sprouts appeared on all stumps during the first month after the original stem was cut. Ninety-eight percent of the sprouting occurred during the first 3 months. The maximum number of sprouts per stump was recorded during the third month, averaging 16 and ranging from 3 to 43 at that time. By 6 months, natural mortality decreased the average number of sprouts per stump to 11 and after 18 months to 6 sprouts *(table 1)*. All sprouts on 3 percent of the stumps died from unknown causes. The number of sprouts per stump increased as stump diameter increased. The number of sprouts per stump also increased as stump height increased up to about 7 inches and remained about constant thereafter.

Table 1–*Development of Australian toon and tropical ash sprouts 6, 18, and 30 months after original stems were cut, Waiakea and Olaa Forest Reserves, Hawaii*

Months after stumping	Stumps with sprouts	Sprouts per stump		Dominant sprouts		
				Height		Vigorous, acceptable form
		Average	Range	Average	Range	
	Pct.			*– Feet –*		*Pct.*
Australian toon						
6	100	11	1-27	6.0	1-12	(1)
18	97	6	0-13	12.5	3-25	95
30	97	[2] 1	–	17.5	3-31	88
Tropical ash						
6	95	8	0-27	4.0	1-9	(1)
18	85	7	0-22	10.5	1-19	88
30	82	[2] 1	–	14.0	6-25	82

[1] Sprouts generally not large enough to be rated.

[2] Only one dominant sprout because of pruning at 18 months (see *table 2*).

Vigor and form–After 30 months, 88 percent of the live stumps supported a dominant sprout of high vigor and of acceptable form for a potential sawtimber tree.

Dominant sprout–The dominant sprouts averaged 12.5 feet tall after 18 months *(table 1)*. By 30 months, they averaged 17.5 feet in height and 1.8 inches in d.b.h. The height and d.b.h. of the dominant sprouts were positively correlated with stump diameter throughout the range of the sample.

Resprouting–During the 12 months after all but the dominant sprouts were cut off, 57 percent of the stumps resprouted. An average of four new sprouts developed. New sprouts grew an average of 2.5 feet in height and were generally less vigorous than the dominant sprout *(table 2)*.

Tropical Ash

Sprouts per stump–Sprouts appeared during the first month after the original stem was cut. Within 3 months the maximum number of stumps sprouted–95 percent. Between 6 and 30 months, the number of stumps with sprouts decreased from 95 to 82 percent. The cause of the decrease is not known. The number of sprouts per stump averaged nine at 3 months and had only decreased to seven by 18 months. The number of sprouts per stump was not correlated with stump diameter or stump height.

Vigor and form–After 30 months, 82 percent of the live stumps supported a dominant sprout of high vigor and of acceptable form for a potential sawtimber tree.

Table 2–*Development of Australian toon and tropical ash resprouts 1 year after all but the dominant sprouts were pruned, Waiakea and Olaa Forest Reserves, Hawaii*

Species	Stumps with resprouts	Resprouts per stump		Dominant resprouts		
				Height		High vigor
		Average	Range	Average	Range	
	Pct.			*– Feet –*		*Pct.*
Australian toon	57	9	0-10	2.5	1-9	65
Tropical ash	85	5	0-18	4.5	1-9	96

Dominant sprout–The height of the dominant sprout per stump averaged 10 feet at 18 months *(table 1)*. By 30 months, the dominant sprouts averaged 14 feet in height and 1.3 inches d.b.h. The average height of the dominant sprouts was not correlated with initial stump diameters. The average d.b.h. of the dominant sprout was positively correlated with initial stump diameter. Stump height was not correlated with either dominant sprout height or d.b.h.

Resprouting–During the 12 months after all but the dominant sprouts were cut off, an average of five resprouts developed on 85 percent of the stumps. New sprouts averaged about 4 feet in height and 96 percent had high vigor *(table 2)*.

DISCUSSION

This study indicates that coppicing provides a method of converting cull trees of Australian toon

Figure 2—This 30-month old Australian toon sprout stood 25 feet tall and measured 2.7 inches d.b.h., and had excellent form and vigor.

and tropical ash to acceptable trees *(fig. 2)*. Sprouts developed readily on stumps of both species; more than 97 percent of the Australian toon and 82 percent of the tropical ash stumps supported vigorous sprouts 30 months after the original stems were cut. Sprouts of Australian toon and tropical ash averaged 17.5 feet and 14 feet in height respectively, after 30 months. But more important, a high percentage of the dominant sprouts of both species had acceptable form. They generally did not have the leaning, arched, forked, and branchy characteristics of the original stems.

The profusion of sprouts can be detrimental to conversion objectives. If all sprouts on a stump were allowed to develop, many multiple-stem trees would occur. To prevent this development, all but the best sprout had to be pruned. After the sprouts were pruned, resprouts occurred on 57 percent of the Australian toon stumps and on 85 percent of the tropical ash stumps. The Australian toon resprouts posed no serious competition to the dominant sprout after 30 months. Tropical ash resprouts, on the other hand, were competing sufficiently with the dominant sprout after 30 months to require their removal. Thus, converting cull Australian toon trees to acceptable trees is a two-step operation: (1) cut the original stem, and (2) cut all but the dominant sprout on a stump. Conversion of tropical ash requires an additional step: cut off resprouts.

Sprouts of both Australian toon and tropical ash are firmly attached to their stumps. Stump decay does not appear to be a factor for either species. We noted decay only on stumps without sprouts. Sprouts on several of the smaller stumps had completely overgrown the cut area.

NOTES

[1]Wick, Herbert L., Robert E. Nelson, and Libert K. Landgraf. *Australian toon planted in Hawaii: tree quality, growth, and stocking.* USDA Forest Serv. Res. Paper PSW-69. Pacific Southwest Forest and Range Exp. Stn., Berkeley, Calif. 10 p., illus. 1971.

[2]Walters, Gerald A. *Coppicing to convert small cull trees to growing stock.* USDA Forest Serv. Res. Note PSW-272. Pacific Southwest Forest and Range Exp. Stn., Berkeley, Calif. 4 p., illus. 1972.

The authors

GERALD A. WALTERS is assigned to timber and watershed resource development studies at the Station's Institute of Pacific Islands Forestry, Honolulu, Hawaii. He received B.S. (1965) and M.S. (1967) degrees in forestry from the University of Missouri. He joined the Forest Service in 1966. **HERBERT L. WICK** was formerly on the staff of the Station's Institute of Pacific Islands Forestry, headquartered in Honolulu, Hawaii. He is now supervisory forester, Estacada Ranger District, Mt. Hood National Forest, Oregon.

U.S. Forest Service research in Hawaii
is conducted in cooperation with
Division of Forestry
Hawaii Department of Land and Natural Resources

G. P. O. 794-469/4610